

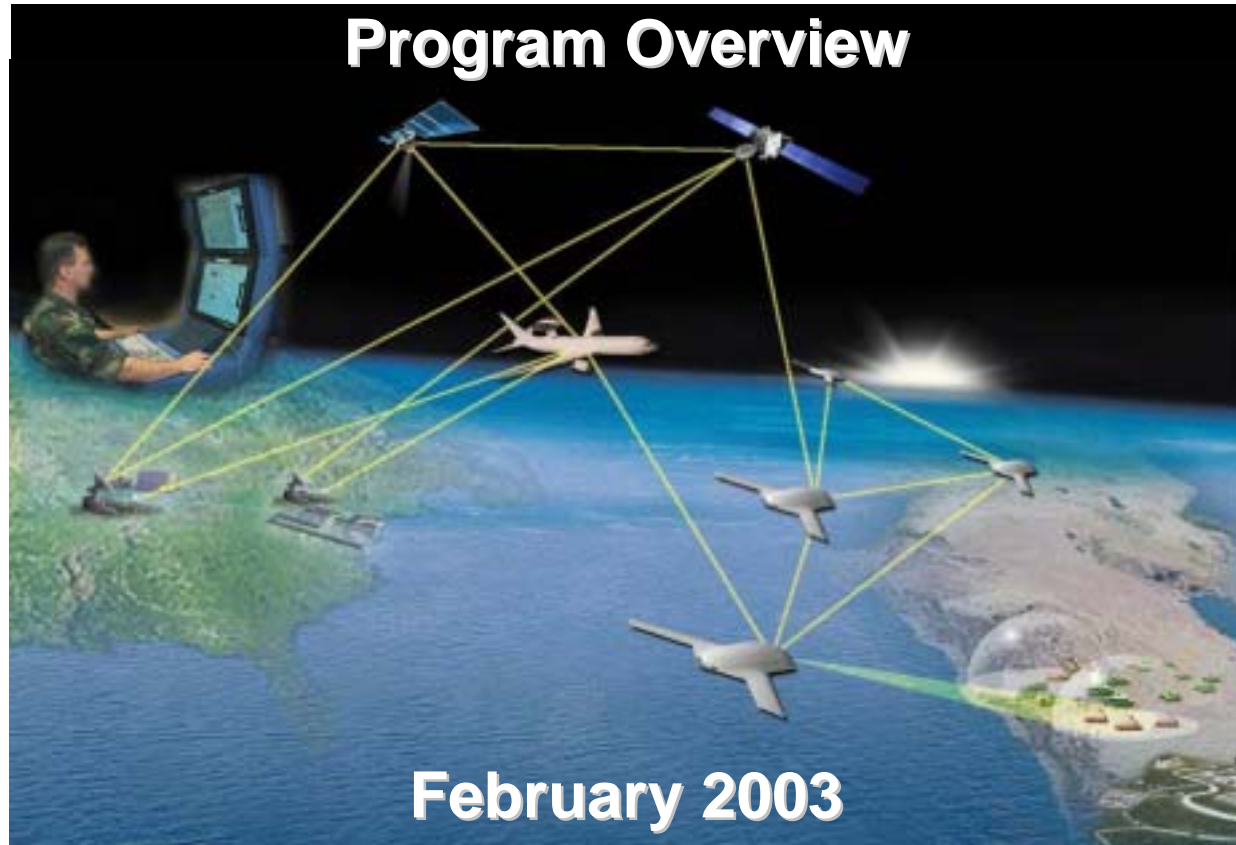


U.S. AIR FORCE



DARPA/USAF

Unmanned Combat Air Vehicle System Demonstration Program



February 2003

Col Earl Wyatt

Program Director

PUBLIC RELEASE

Approved for Public Release Case # 41942 - Distribution Unlimited



Program Goal & Objectives



Demonstrate the technical feasibility for a UCAV system to effectively and affordably prosecute 21st century SEAD/EA/Strike missions within the emerging global command and control architecture.

- **Develop**
 - a low life-cycle cost, mission effective design for a SEAD/EA/Strike unmanned combat air vehicle
 - a re-configurable control station for multi-ship ops
 - robust/secure command, control & communications, LOS & BLOS
- **Evaluate**
 - human computer function allocation, dynamic mission planning & management approaches
 - off-board/on-board sensor integration, weapon targeting & loadouts
- **Demonstrate**
 - human-in-the-loop; detection, identification, location, real-time targeting, weapons authorization, weapons delivery and target damage indication.
- **Continue refinement & assessment of operational SEAD/EA/Strike UCAV design**



UOS Primary Mission Set

(UCAV Objective System)



- Pre-emptive and Reactive Lethal Attack
- Non-Lethal Electronic Attack

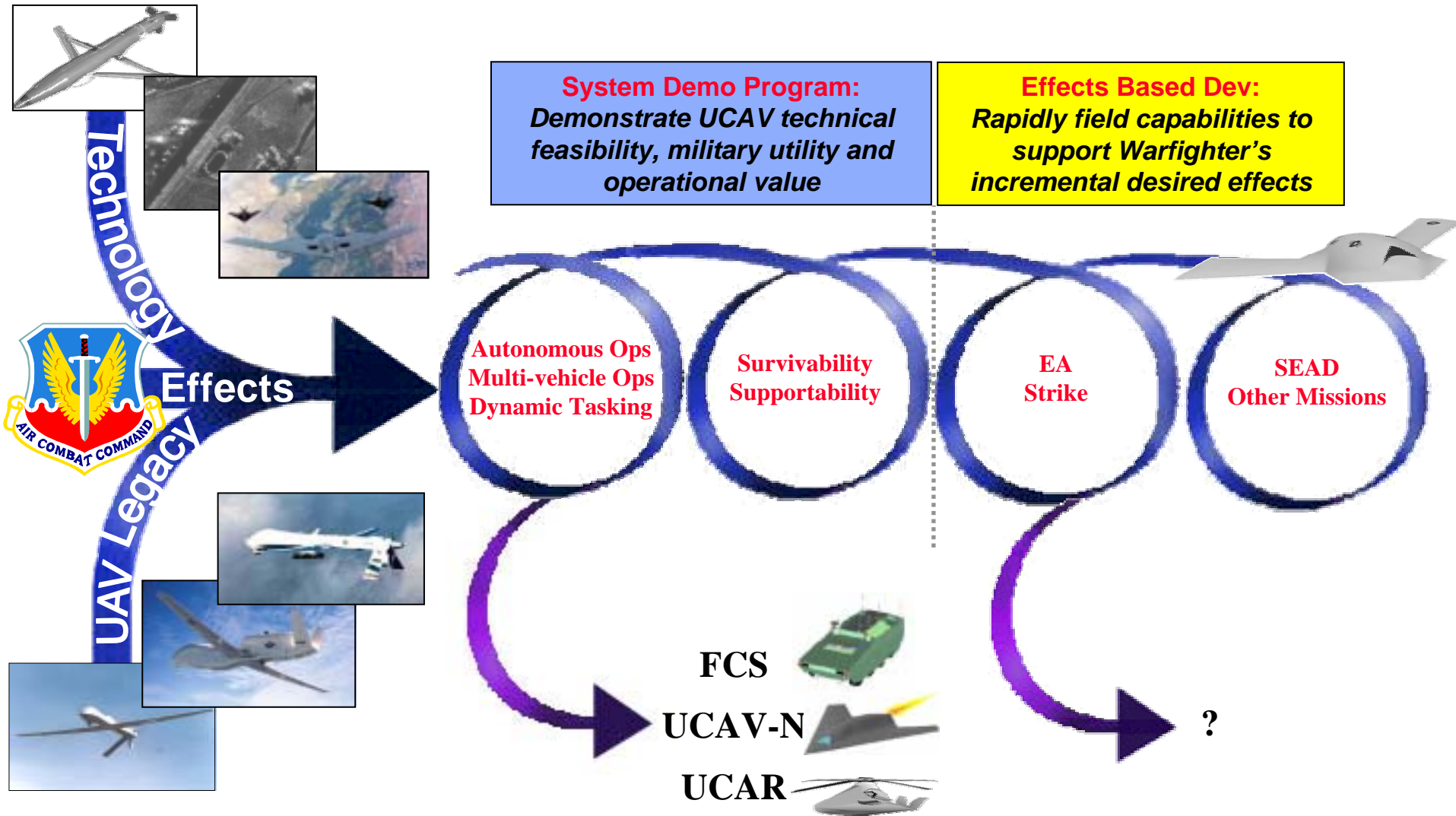
F2T2EA Functions

- Find
- Fix
- Track
- Target
- Engage
- Assess

**CONOPS developed in collaboration
with USAF**



UCAV Strategy



UCAV X-45

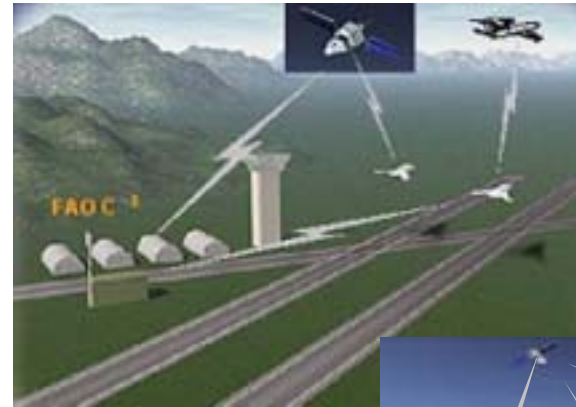
PUBLIC RELEASE

Approved for Public Release Case # 41942 - Distribution Unlimited



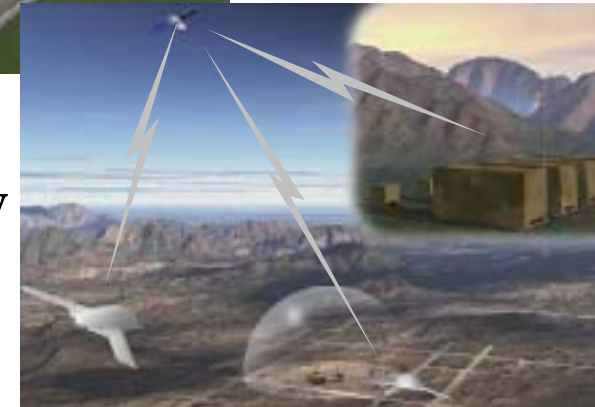


Mission Control Attributes (Objective System)



**Friendly Area
Operations**

**Area Of
Responsibility**



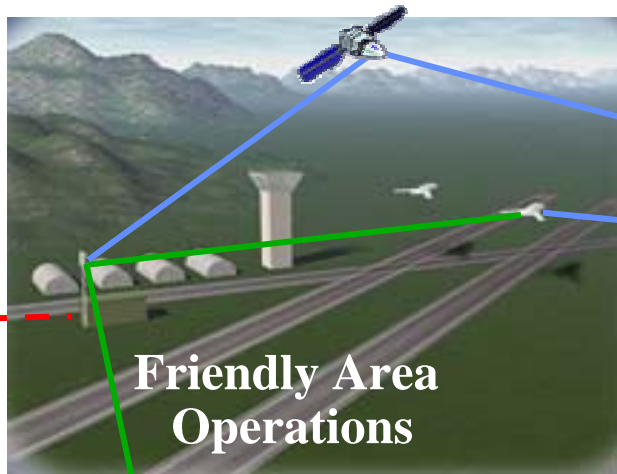
- Operator Task Allocation by Phase of Mission
- Dynamic Mission Planning & Replanning
- Single Operator Controls Multiple Vehicles
- Robust secure LOS, BLOS & intra-flight C2
- Dynamic Distributed Control
- Multiple Levels of Autonomy
- Uses Theater and National Information Sources



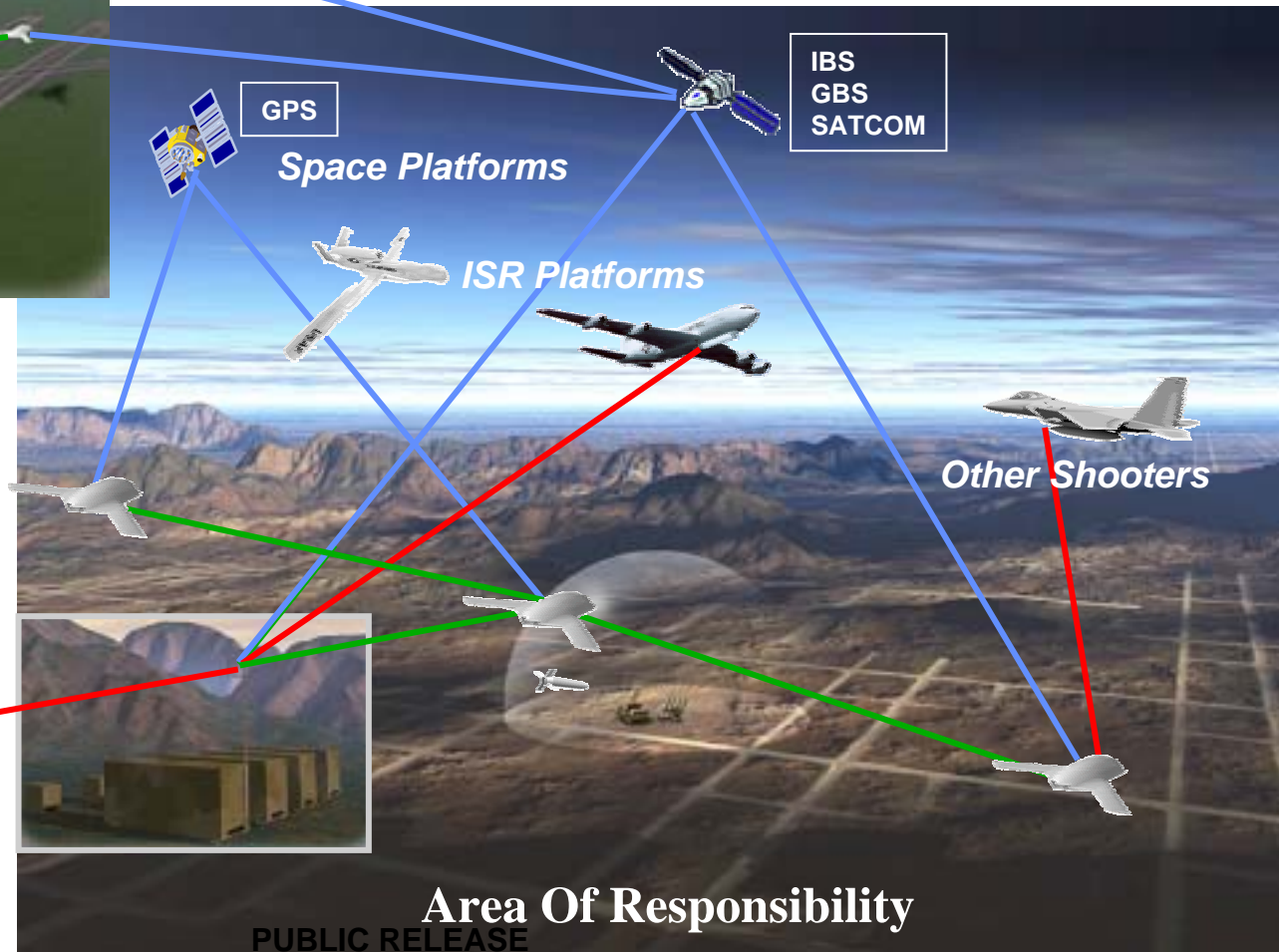
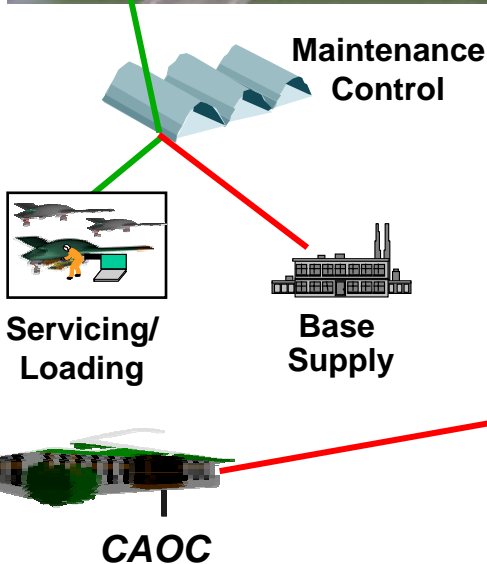
Distributed Adaptive Control Interfaces



U.S. AIR FORCE



- External Interfaces
- Internal Interfaces
- Long Haul Interfaces
- Space interfaces



UCAV X-45

PUBLIC RELEASE



Objective System Focuses Demonstrator System



UCAV Objective System (UOS)

- Effective & Affordable Force Enabler for Post 2010 SEAD/Strike Mission
- Product of Multi-Dimensional Optimized / Trade Studies
- Designed to Identify the Critical Technologies/Processes/System Attributes

X-45 Demonstrator System

- Best Value That Maintains Legacy to UOS
- Focused by UOS to Address Critical Technologies, Explore CONOPS Design Space & Validate UOS Key Assumptions

Critical Technologies,
Processes, & System Attributes

- Air Vehicle
- Control Segment / Architecture
- Communications
- Information Architecture/ Situation Awareness
- Targeting
- Weapons
- Signature
- Supportability



UCAV X-45

PUBLIC RELEASE

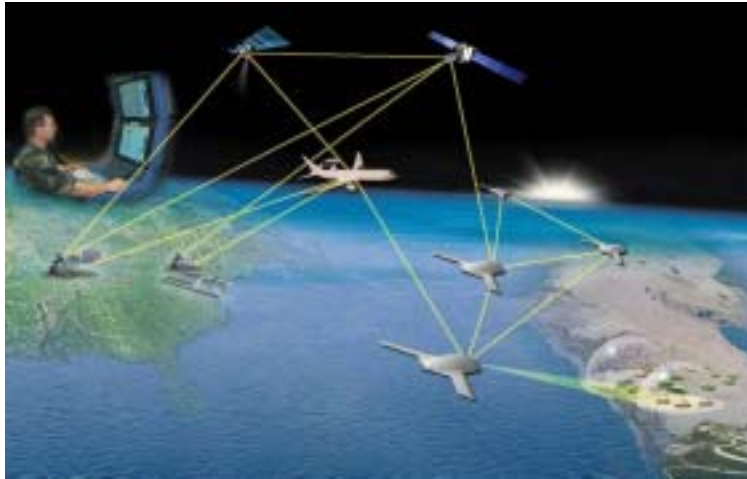
Approved for Public Release Case # 41942 - Distribution Unlimited





Technologies, Processes & System Attributes

Disciplined Path to Enable Combat Capability



Air Vehicle

✓ **Critical** + UCAV Unique

- (av-01) Affordable Air Vehicle Unit Recurring Flyaway (URF) Cost
- (av-02) Weapons Suspension and Release
- (av-03) Survivable Air Vehicle Integration

Mission Control System

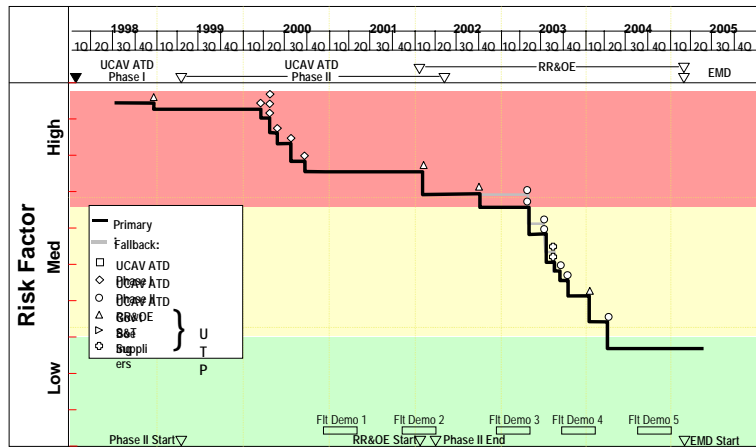
- (mcs-01) Dynamic Distributed Mission/Vehicle Control
- (mcs-02) ✓ **Advanced Cognitive Aids Integration, Mission Planning**

System Integration

- (si-01) Advanced Targeting and Engagement Process
- (si-02) ✓ **Force Integration, Interoperability, and Information Assurance**
- (si-03) ✓ **Secure, Robust Communication Capability**
- (si-04) ✓ **+ Adaptive, Autonomous Operations**
- (si-05) Affordable Large Scale Software Dev/Integ
- (si-06) + Coordinated Multivehicle Flight/Motion

Support System

- (spt-01) + Affordable Operations / Support Cost, and Integrated Vehicle Health Management
- (spt-02) LO Maintainability
- (spt-03) + Mobility, Rapid Deployment and Footprint
- (spt-04) Sortie Rate, Turn Time and Ground Ops





X-45A Demonstrator Toolkit

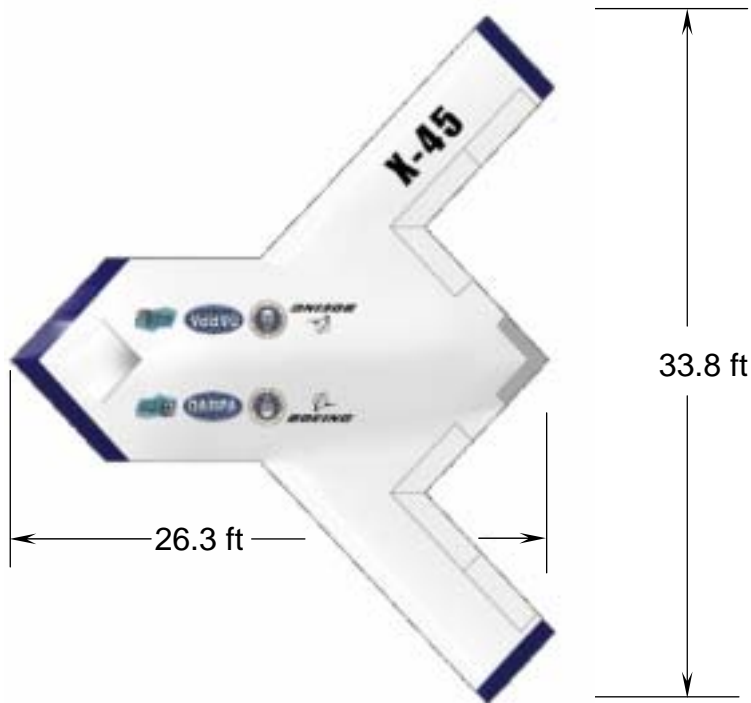


PUBLIC RELEASE

Approved for Public Release - Distribution Unlimited



X-45A Configuration



Empty Weight: 8,000 lb
Fuel Volume: 2,690 lb
Payload Capability: 1,500 lb
Operating Altitude: 35,000 ft
Cruise Mach: 0.75
Honeywell F124-GA-100 Engine



Spiral 0: Flight Demo Progress



- ☑ Both X-45A vehicles delivered to Dryden
- ☑ AV1 First Flight • May 02
- ☑ AV2 First Flight • Nov 02
- ☑ Block 1 flights complete • Feb 03
- ☐ Block 2 flight demos start • Spring 03
- ☐ Block 2 multi-AV flights • Summer 03



UCAV X-45

PUBLIC RELEASE

Approved for Public Release Case # 41942 - Distribution Unlimited





Spiral 0: Block 1 Flight Demo Summary

As of 28 Feb 03



- **Air Vehicle 1**
 - Total number of flights: 14
 - Total Flight Time: 11.6 hours
 - Completed envelope expansion, 4D Nav, loss-of-comm and C² demos
 - 48 of 48 demonstrations complete
- **Air Vehicle 2**
 - Total number of flights: 2
 - Total AV2 Flight Time: 1.2 hours
 - Currently undergoing upgrades for Block 2 demonstrations

- **Flight demonstrations successful**
- **Validating technical feasibility of UCAV concept**



Spiral 0: Block 2 Demo Progress

As of 28 Feb 03



- ☒ Build 2.0 Simulation • Oct 02
- ☒ AV2 First Flight • Nov 02
- ☒ T-33 First Flight with Build 2.0 • Dec 02
- ☐ X-45A Flights with Build 2.1 • Spring 03
- ☐ Block 2 multi-AV flights • Summer 03
- ☐ Block 2 flights complete • Fall 03



Block 2 will demonstrate multi-vehicle coordinated ops



UCAV Capabilities by Software Build



Build 1.0



Build 2.1



Build 5.1



Build 3.0



Build 4.0

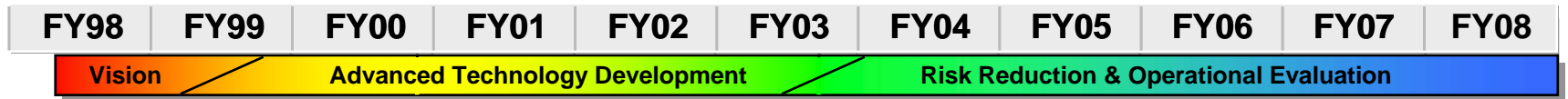


PUBLIC RELEASE

Approved for Public Release Case # 41942 - Distribution Unlimited



UCAV Path to Combat Ops



UOS Analysis

System A Design/Fab/Int/SCO



Blk 1 S/W & Demos

Blk 2 S/W & Demos

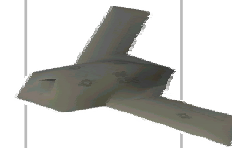
Blk 3 S/W & Demos

Blk 4 S/W & Demos

UOS Refinement

System B Design/Fab/Integ/SCO

Blk 5 S/W & Demos



Incubation

Program Cycle Timeline

-3

-2

-1

1

2

3

4

5

6

7

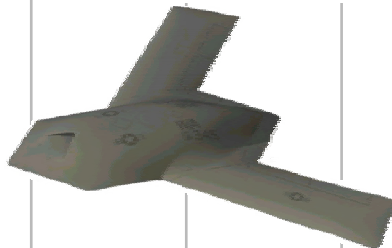
■ Spiral 0 - Core Functionality & Vision Push

■ Spiral 1 - Robust LO Air Vehicle

■ Spiral 2 - Payloads & Productization

Effects Based Development

Future Spiral Development



UCAV X-45

PUBLIC RELEASE

Approved for Public Release Case # 40141 - Distribution Unlimited





Spiral 0 Demo End-State



PD SEAD CONOPS

Multi-Vehicle Coordinated/Distributed Flight

Dynamic Retasking Replanning

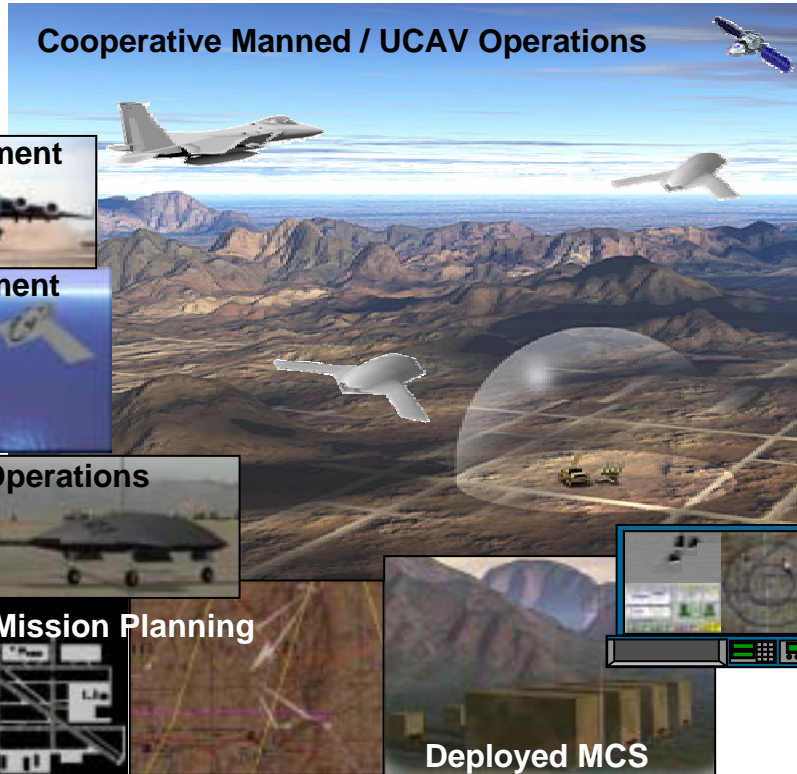
Weapon Release

- Fixed Geometry Taxi
- Autonomous Ground Ops

- **Multi-Vehicle Operations**
 - Inter-Vehicle Comm
 - Dynamic/Reactive Taxi
 - Coordinated Flight
 - » Rendezvous
 - » Escort Formations
 - » CAP/Loiter Patterns
 - » Collision Avoidance
 - Contingency Management
 - Distributed Control
 - Dynamic Retasking/Replanning
 - Cooperative targeting
- **End-to-End Demonstrations**
 - Single-ship Preemptive Destruction
 - Single-ship Reactive Destruction



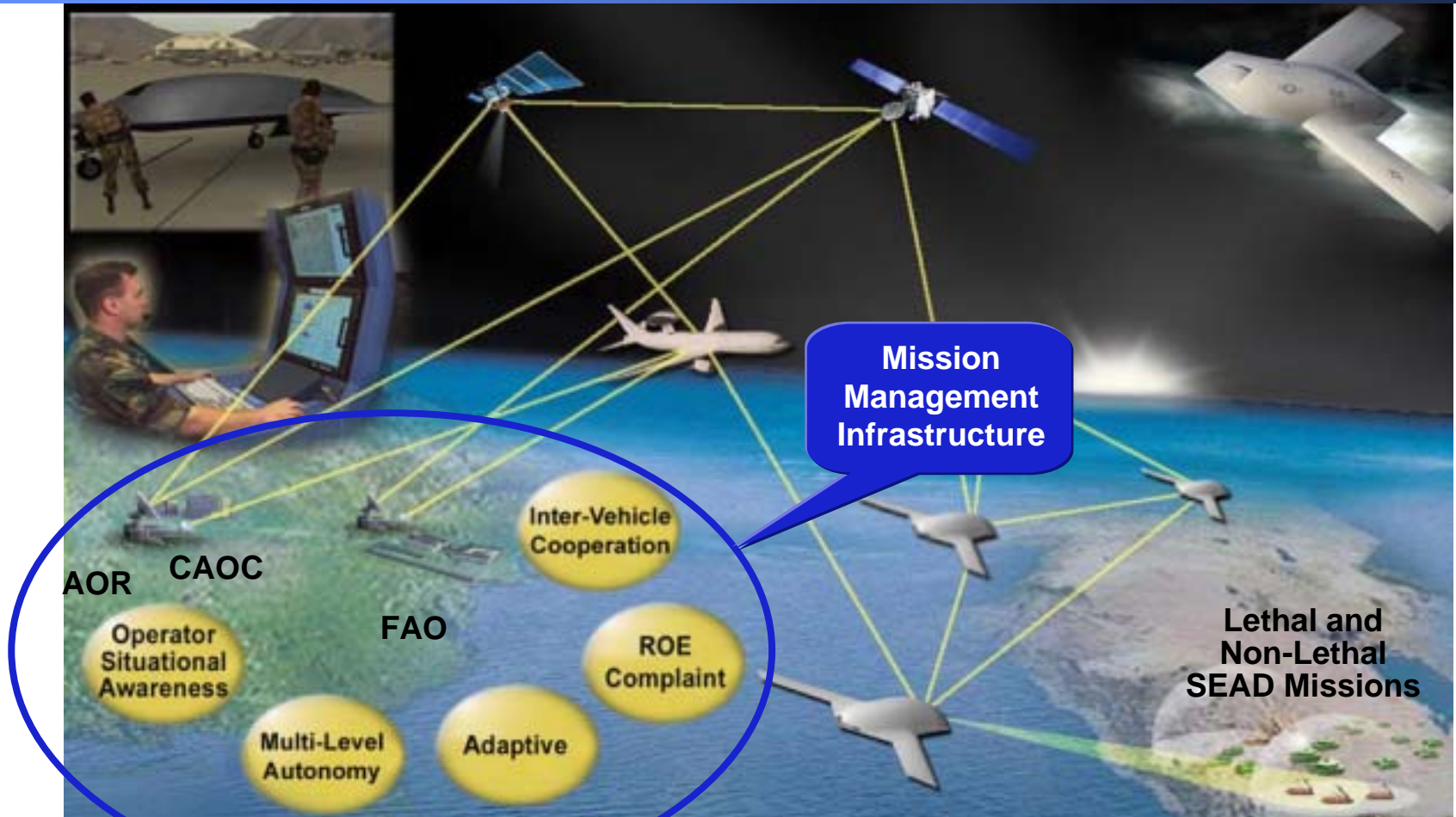
Spiral 1 Demo Highlights



- **Spiral 1 AV Performance**
 - Flight Envelope / Weapons Drops
 - Survivability / Affordability
- **Battlespace Interoperability**
 - Safe Operation Around Manned Aircraft
 - Use Off-board Targeting Info
- **Multi-Vehicle Operations**
 - Port Block 4 Functionality to Robust Air Vehicle
- **Supportability**
 - Deployment / Weapon Loading / Turn Time
 - LO Maintainability Evaluation



UCAV System Demo End State



UCAV System Demo Program delivers multi-ship C2 operations, affordable LO air vehicle and interoperability with manned aircraft



Summary



- **UCAV's program strategy enables the introduction of combat capability incrementally**
 - Key technologies, processes, and systems attributes identified and structured to valid key assumptions
- **Demonstration program (Spirals 0/1) integrates robust mission management infrastructure, global C2 & affordable LO aircraft**
 - Ground and flight demonstration results to date are very encouraging
 - Multi-vehicle single operator demonstration this summer a critical milestone



For more information, visit www.darpa.mil/ucav

PUBLIC RELEASE

Approved for Public Release - Distribution Unlimited